

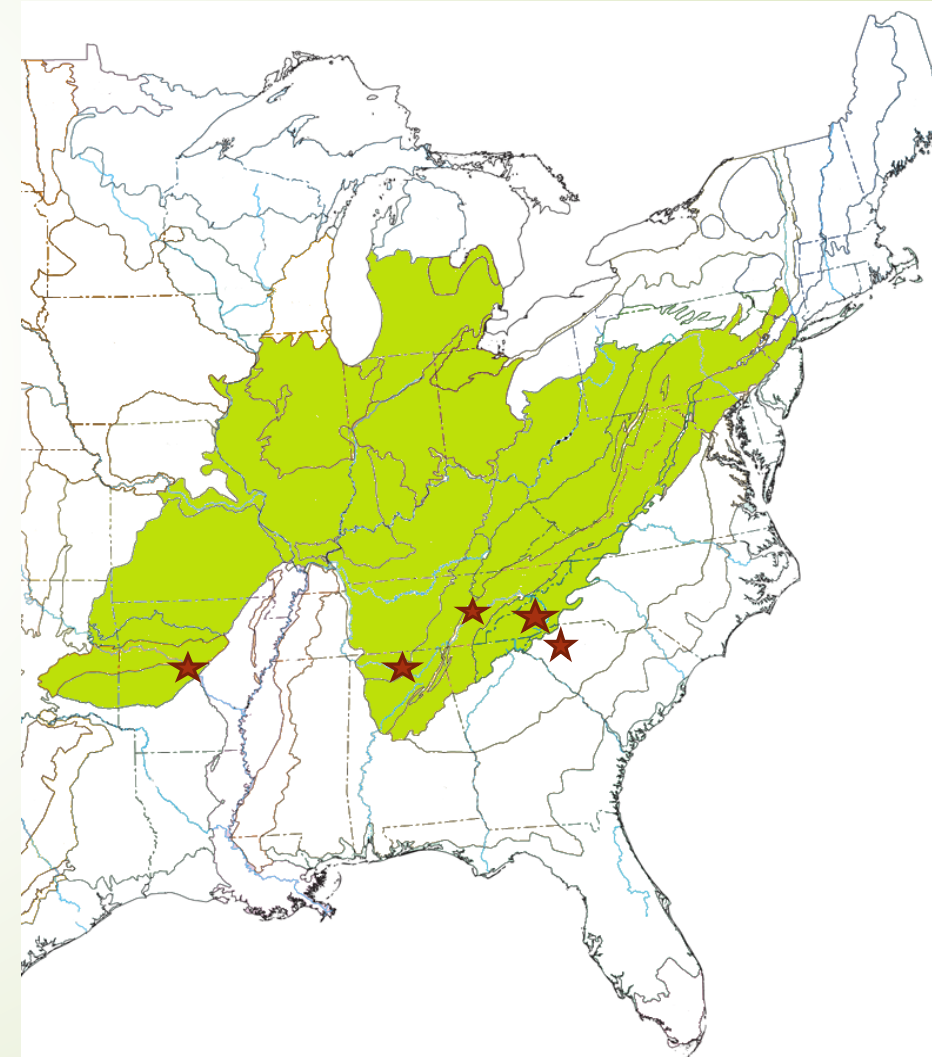
HARDWOOD FOREST RESTORATION IN THE APPALACHIANS

A wide-angle landscape photograph of a hardwood forest in the Appalachian region. The foreground and middle ground are filled with dense, brownish-gold trees, indicating a late autumn or winter season. A large, dark shadow is cast across the valley floor from the right. In the background, rolling mountain ridges are visible under a clear blue sky. On the right side, a steep, rocky cliff face rises above the forest canopy.

Upland hardwood Ecology and Management Work Unit (RWU-4157),
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Upland Hardwoods Ecology and Management (RWU-4157)

- Mission is to develop and disseminate knowledge and strategies for restoring, managing, sustaining, and enhancing the vegetation and wildlife of southern upland hardwood forests.
- Our research program focuses on understanding and predicting how upland forests and wildlife species/communities are affected by natural and silvicultural disturbances across the broad edaphoclimatic gradients characteristic of the CHR.
- Staff: Research Foresters (6), Research Ecologists (2), Ecophysiologicalist (1; *Project Leader, Kurt H. Johnsen*), Technicians (5), Administrative support (3)



Issues/concerns

- Oak regeneration
 - In actively managed stands, but also at the broader landscape-level
- Conservation and/or restoration of diversity – structural and compositional
 - Yellow-poplar and white pine dominated stands
 - Increase response diversity of single-species stands to future disturbance

Acres (thousand)

5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0

0-20

21-40

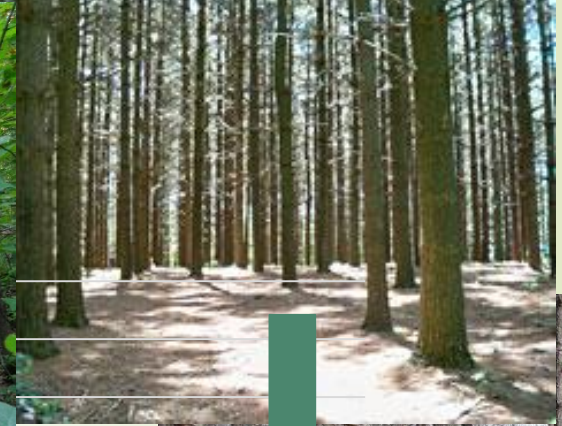
41-60

61-80

81-100

100+

Total



Oak regeneration – stand level silviculture

- ▶ Success dependent on the amount and size of seedlings in the forest understory **prior** to harvest/disturbance
- ▶ Traditional silvicultural methods often fail to regenerate oak and hickory on all but the most xeric of sites
- ▶ Recent experimental tests of the **oak shelterwood method** (Loftis 1990) by scientists within RWU-4157 as well as observational data collected by NF of NC suggest specifics need to be refined
- ▶ Shelterwood/burn method (Brose 1999)
- ▶ Non-traditional systems are being tested for their ability to regenerate oak and conserve diversity, increase complexity, create a diversity of wildlife habitats



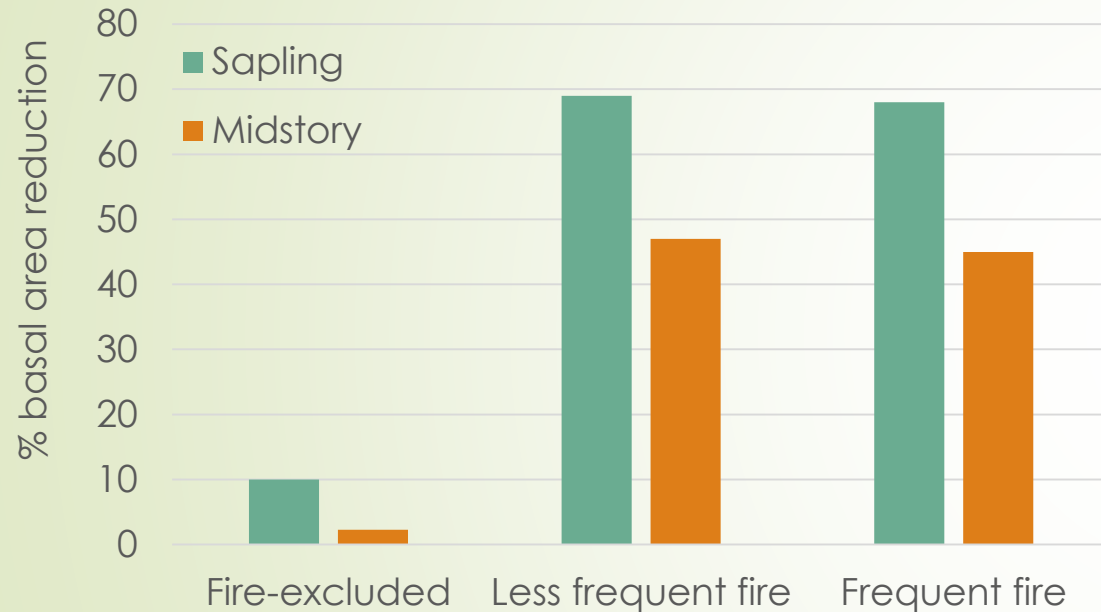
Current prescribed burning studies (vegetation oriented within RWU-4157)

1. Effects of season of burn on structure and composition of Appalachian hardwood stands (Keyser, Greenberg, McNab)
 - ▀ Overstory, regeneration, herbaceous layers, acorn production, herpetofauna, and breeding birds
2. Repeated burning impacts on structural and composition dynamics of overstory, regeneration, and herbaceous layers in productive mixed-hardwood forests (Keyser, Greenberg)
3. Long-term effects of fire frequency on structure and composition of Appalachian hardwood stands in eastern KY (Keyser, Arthur, Loftis, Alexander)
 - ▀ Overstory structure and tree vigor, regeneration layer, species diversity, structural complexity
4. Factors affecting postfire mortality of predominant species in upland forests of the Central Hardwood Region (Keyser, McDaniel, National Park Service fire ecologists)
5. Interacting effects of thinning and fire on stand dynamics in mixed pine/hardwood forests of northern Alabama (Schweitzer)
6. Factors affecting the postfire sprouting of oak, competitor species, and shortleaf pine (Keyser)
7. Creation and maintenance of oak woodland structures (Schweitzer and Clark)

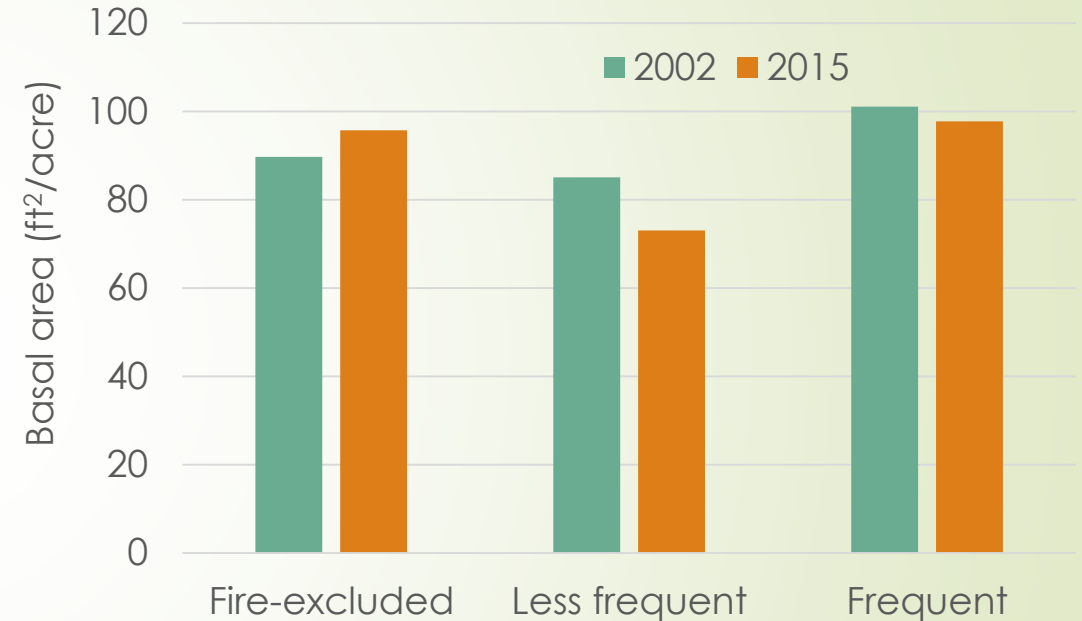
Landscape-level burning and forest structure

(Arthur et al. 2015; Keyser et al. 2017)

Effects on forest structure - subcanopy



Effects on forest structure - overstory



Figures reflect data reconstructed from figures in Arthur et al. (2015); averaged across moisture classes

% change in tree crown vigor

	-3	-2	-1	0	1	2
Fire-excluded	2.8	6.1	1.9	79	9.4	0.47
Frequent fire	14	4.4	3.0	68	10	0.37
Less frequent fire	19	5.2	6.8	62	6.8	0.4

Landscape burning and oak-hickory regeneration potential (Keyser et al. 2017)

- Repeated burning can increase the density of larger, more competitive oak and hickory seedlings in the forest understory
- Frequent burning, however, can restrict recruitment into larger size classes due to repeated top-killing of individuals
- Despite the increase absolute density of larger oak and hickory seedlings, competition with maple and other shade-tolerant (mesophytic species) remains intense
- Questions:
 - Will changes in structure associated with burning permit the continued recruitment of oak/hickory into the canopy?
 - Will additional treatments (mechanical or chemical) be required to control non-oak/hickory species in the forest understory?



Prescribed burning – stand (plot) vs landscape-level effects



Burning and timber quality/value

- ▶ Lose value through:
 - ▶ Mortality: species-specific and related to dbh and severity of fire effects; Keyser et al. in press)
 - ▶ Defect: stain, decay, shakes, check
 - ▶ Changes in log grade are inconsistent
 - ▶ Value loss related to size of scar/damage which is impact by fire intensity and varies by tree species (e.g., RM > Oaks > YP; Wiedenbeck and Schuler 2004)
- ▶ Mitigation measures
 - ▶ Allow wound closure prior to reburn (1-24 years) – Stambaugh et al. (2017)
 - ▶ Manage fire intensity, redistribute harvest residue if burning is coupled with harvest
- ▶ Trade-offs
 - ▶ In areas where timber production is not of primary concern (roadless, unsuitable landbase, limited harvesting operability, low value hardwoods), loss of value may be offset ecological benefits
 - ▶ In the suitable landbase and/or high quality hardwood stands, exclude fire during the pole and small sawtimber stages of stand development



PCK020
Scar size = 2916 cm²
Woundwood = 463 cm²
Decay = 806 cm²
Perc. decay of 1st log = 0.18%

Photo: Stambaugh &
Guyette (2008)

Questions & Discussion

